EDUCATIVE JEE (MATHEMATICS)

Errata to the Revised Reprint

Last updated on October 17, 2010

Entries added in the last two weeks are marked with asterisks.

On p. 48, the answer to the problem at the end of Comment No. 7 simplifies to $\frac{3}{2}$.

On p. 93, although the proof of the identity (14) is not easy, (15) can be proved quite simply by noting that for every $k > n$, $\alpha_i^k + a_1\alpha_i^{k-1} + \ldots + a_{n-1}\alpha_i^{k-n+1} + a_n\alpha_i^{k-n} = \alpha_i^{k-n}p(\alpha_i) = 0$, for every $i = 1, 2, \ldots, n$ and adding these n equations.

On p. 176, a shorter, albeit trickier, proof of the identity (15) can be given by recognising the series on the L.H.S. as a telescopic series. Specifically, for $k \geq 0$, rewrite $2n - 4k + 1$ in the numerator as $(2n - 2k + 1) - 2k$. Then note that the expression $\frac{\binom{2n-k}{k}2^{n-2k}}{\binom{2n-k}{n}}$ is simply $\frac{\binom{n}{k}2^{n-2k}}{\binom{2n-2k}{n-k}}2^{n-2k}$ while the expression $\frac{\binom{2n-k}{k}2k2^{n-2k}}{\binom{2n-k}{n}(2n-2k+1)}$, upon simplification, equals $\frac{\binom{n}{k-1}}{\binom{2n-2k+2}{n-k+1}}2^{n-2k+2}$. Hence the k-th term of the L.H.S. can be expressed as $A_k - A_{k-1}$ where $A_k = \frac{\binom{n}{k}}{\binom{2n-2k}{n-k}}2^{n-2k}$. Since $A_{-1} = 0$, the sum equals A_m which is precisely the R.H.S. (Contributed by Gaurav Bhatnagar.)

On p. 189, the easiest solution to Exercise (5.11) requires the properties of ω, the complex cube root of unity. So the exercise may be postponed till after Chapter 7.

On p. 264, in line 1, the reader is asked to show that the quadrilateral $DRFV$ is cyclic. Once this is done, the rest of the proof follows easily from the basic properties of the nine point circle of a triangle. But the proof of cyclicity of the quadrilateral $DRFV$ is not so easy. For one such proof, in the figure on p. 263, join F and R. Let the internal angle bisector AP meet BC at J. Also drop perpendicular PG from P to BC. Call the angles $\angle ABC, \angle DAC$ and $\angle JAD$ as β, α and θ respectively. Then $\beta = \angle B$ while $\alpha = 90° - \angle C$. As in the diagram, without loss of generality we take $\angle B \leq \angle C$, so that $\theta = \frac{1}{2}(\angle C - \angle B)$ as is easy to show. Note that since $RA = RP$, $\angle APR$ and hence $\angle VPJ$ also equals θ. The cyclicity of the quadrilateral $DRFV$ can be proved by showing that $\angle DVR$ and $\angle DFR$ each equals $\alpha + \beta$. The first one follows by observing that in the right angled triangle VGP, $\angle VPG = \angle VPJ + \angle JPG = \theta + \angle JAD = 2\theta$. As for $\angle DFR$, we split it as $\angle DFC + \angle CFR$. The first part is α by the cyclicity of the quadrilateral $FDCA$. The second part equals $\angle FHR$ because FR is a median of the right-angled triangle AFH. But $\angle FHR = \angle B = \beta$ by cyclicity of the quadrilateral $BFHD$.

On p. 278, the parenthetical remark at the end of the page is incorrect. The result as well as the proof goes through even if the quadrilateral is not convex.

On p. 283, the solution can be simplified considerably. Instead of specifying the points z_0 and z_1, let them be any two distinct points on the line L. Then there exists a complex number λ such that $z_2 = (1-\lambda)z_0 + \lambda z_1$ and $z_3 = (1-\overline{\lambda})z_0 + \overline{\lambda}z_1$. Therefore the expression $\overline{z_2}b + z_3\overline{b}$ equals $(1-\overline{\lambda})(b\overline{z_0} + \overline{b}z_0) + \overline{\lambda}(b\overline{z_1} + \overline{b}z_1)$. But since the points z_0, z_1 lie on the line L, each of the expressions $b\overline{z_0} + \overline{b}z_0$ and $b\overline{z_1} + \overline{b}z_1$ equals c. Therefore $\overline{z_2}b + z_3\overline{b} = (1-\overline{\lambda})c + \overline{\lambda}c = c$. An alternate solution, not based on (16), can also be given by observing that (i) the midpoint of the segment joining z_2 and z_3 lies on L and (ii) this segment is perpendicular to L. By (i), $b(\overline{z_2}+\overline{z_3}) + \overline{b}(z_2+z_3) = 2c$ while by (ii), $z_2 - z_3$ is a real multiple of b, and hence $(z_2 - z_3)/b = (\overline{z_2} - \overline{z_3})/\overline{b}$, i.e. $b(\overline{z_2} - \overline{z_3}) - \overline{b}(z_2 - z_3) = 0$. These two equations together imply $b\overline{z_2} + \overline{b}z_3 = c$.

On p. 297, the figure is misleading. The circle ought to cut the coordinate axes and OA should be a diameter of it.

On p. 302, in Figure (a), the points P and C should be joined to each other by a straight line.

On p. 303, in the problem solved in Comment No. 10, the locus is already given except for the value of λ which is to be found. This can be done simply by identifying any one point on the locus. By symmery of the circle w.r.t. the axes, it is obvious that the intercept between the axes of the tangent at the point $(2+\sqrt{2}, 2+\sqrt{2})$ will have this point as its midpoint. Hence $x = 2+\sqrt{2}, y = 2+\sqrt{2}$ must satisfy the equation of the locus. So, $4+2\sqrt{2}-(2+\sqrt{2})^2+\sqrt{2}\,\lambda(2+\sqrt{2}) = 0$ which gives $\lambda = 1$. (Pointed out by Ananth Kumar.)

On p. 313, the first part of the solution, viz. to get the equation of a typical member of the family of circles passing through A and B can be generalised as follows. Given two (distinct) points $A = (x_1, y_1)$ and $B = (x_2, y_2)$, let C_1 be any circle passing through them. Write the equation of C_1 in the form $E_1 = 0$. Next, we write the equation of the line L joining A and B in the form $E_3 = 0$. Then any circle passing through A and B has its equation of the form $E_1 + \mu E_3 = 0$. It does not matter which circle C_1 we choose as long as it passes through A and B. (If we change C_1 to, say C_1', E_1 will change to E_1' (say). But E_3 will not change and by changing the value of μ to some μ' we can ensure that $E_1 + \mu E_3 = E_1' + \mu' E_3$, because $E_1 - E_1'$ is a multiple of E_3.) One canonical choice is to take C_1 as the circle having AB as a diameter. For any point P on this circle, the lines PA and PB are at right angles to each other. So the equation of C_1 is $E_1 = 0$ where $E_1 = (x-x_1)(x-x_2) + (y-y_1)(y-y_2) = 0$. Thus we see that the 1-parameter family of all circles passing through two points $A = (x_1, y_1)$ and $B = (x_2, y_2)$ is

$$(x-x_1)(x-x_2) + (y-y_1)(y-y_2) + \mu E_3 = 0 \tag{1}$$

where $E_3 = 0$ is the equation of the line L passing through A and B. A limiting case of this in which A and B coincide is interesting. In that case L becomes the tangent. Thus, given a line L with equation $E_3 = 0$ and a point $A = (x_1, y_1)$ on it, the 1-parameter family of all circles which touch L at A is given by

$$(x - x_1)^2 + (y - y_1)^2 + \mu E_3 = 0 \tag{2}$$

On p. 349, the justification given for showing that the function $f(x)$ has at least one more zero needs some elaboration and correction. As noted there, $f(3) = 0$ and so 3 is a zero of f. A direct computation gives $f'(3) = 8 \ln 2 - 6$. From the approximate value of $\ln 2$ as 0.6931, $f'(3) < 0$. So, for sufficiently small, positive δ, we have $f(3 + \delta) < 0$. But $f(4) = 1 > 0$. So, by the Intermediate Value Property, somewhere between $3 + \delta$ and 4, f has at least one zero. Alternately, one can observe that since $f(2)$ and $f(4)$ are both positive, f has an even number of zeros in the interval $(-2, 4)$ One of them is 3. But it is not a double zero since $f'(3) \neq 0$. (For this one does not need an approximate value of $\ln 2$. Only its irrationality is enough.)

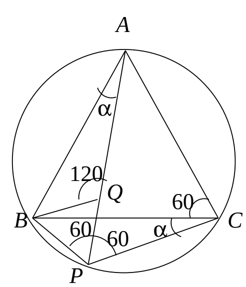
On p. 365, another simpler solution to the Main Problem can be given using the well-known Heron's formula for the area of the triangle ABC, viz. $\Delta = \sqrt{s(s-a)(s-b)(s-c)}$ which, in the present case becomes simply $\Delta = \sqrt{sr_1r_2r_3}$. Squaring and using (1) on the same page gives $r^2s^2 = sr_1r_2r_3$ and hence $\dfrac{r_1r_2r_3}{s} = r^2$. (Pointed out by Aveek Sen.)

On p. 369, in the figure the line ID should be perpendicular to the side BC.

On p. 386, the problem solved in Comment No. 10 beginning is popularly known as the **Steiner-Lehmus theorem**. The trigonometric solution given on p. 388 needs correction because the formula for the length of the angle bisector is wrongly quoted. The correct formula involves the cosine and not the sine of half the corresponding angle. Using the correct formula, Equation (30) should be replaced by $(bc + ac) \cos \frac{B}{2} = (bc + ab) \cos \frac{C}{2}$. If $b > c$ then the first factor of the L.H.S. is smaller than that of the R.H.S. Further, in this case we also have $0 < \frac{C}{2} < \frac{B}{2} < \frac{\pi}{2}$ and hence $\cos \frac{B}{2} < \cos \frac{C}{2}$. Hence the second factor of the R.H.S. is also less than the second factor of the R.H.S. As all the factors are positive, we get a contradiction.

On p. 392, Exercise (11.38) is newly added. A solution for it can be given as follows.

For a trigonometric proof, let $\angle BAP = \alpha$ and R be the circumradius. Then the problem reduces to proving $\sin(\alpha + 60°) = \sin\alpha + \sin(60° - \alpha)$. For a pure geometry solution, take Q on AP so that $PB = PQ$. Then since $\angle BPQ = \angle BCA = 60°$, the triangle BPQ is equilateral. This makes $\angle BQA = 120°$ and $\Delta BQA \equiv \Delta BPC$. Ptolemy's theorem also gives the result directly. But a solution using complex numbers appears awkward.



On p. 394, the calculations in the solution to the Main problem can be simplified a little by observing that since the answer depends only on the relative proportions of the lengths involved, we are free to choose the units. Taking $AM = 1$, we get, in succession, $h = \tan 60^\circ = \sqrt{3}$, $MB = h \cot 30^\circ = \sqrt{3} \times \sqrt{3} = 3$, $r = \frac{1}{2}(MB - MA) = 1$, $OM = 2$, $MC = \sqrt{1+4} = \sqrt{5}$ and finally, $\tan\theta = \dfrac{\sqrt{3}}{\sqrt{5}}$. (Contributed by M. R. Railkar.)

On p. 435, the correct answer to Exercise (6.18) is the interval $(2, \infty)$ and not the interval $(1, 2)$ as given. The reason is that since the base of the logarithm on the L.H.S. (viz. 0.3) is less than 1, $\log_{0.3}(x-1) < 0$ implies that $x - 1 > 1$ and not $x - 1 < 1$ as claimed. (Pointed out by Manzil Zaheer.)

On p. 445, in the answer to Exercise (8.8)(b), an additional condition to ensure that the points z_1, z_2, z_3, z_4 are not collinear (for example, one based on Exercise (8.24)) is needed. (Pointed out by Ananth Kumar.)

On p. 448, the correct answer to Exercise (9.3) is 'one' since the first circle touches the second one internally. (Pointed out by P. N. Ramachandran.)

On p. 448, add the following line at the end :

as a diameter is $(x - x_1)(x - x_2) + (y - y_1)(y - y_2) = 0$ as can be obtained

On p. 449, in the solution to Exercise 15(c), interchange subscripts 1 and 2.

On p. 450, in the figure at the bottom, interchange P and Q. Also, take P as $(a, 0)$ instead of (a, b). (Pointed out by Prateek Ghelot.)

On p. 452, the correct answer to Exercise (9.35) is $\frac{15a^2}{4}$ as the points of contacts with the circle are $(-a/2, \pm a/2)$. (Pointed out by P. N. Ramachandran.)

On p. 453, the correct answer to Exercise (9.41) is $y + 10 = \frac{1}{3}(x - 1)$. (Pointed out by Manzil Zaheer).

On p. 453, the answer to Exercise (9.47) is $3(3 + \sqrt{10})$ as the radius is 3 (and not 1). (Pointed out by P. N. Ramachandran.)

On p. 454, in the answer to Exercise (9.50), the points A, B are $(0, 0)$ and $(1, 1)$ and so the answer is $x(x - 1) + y(y - 1) = 0$. (Pointed out by Manzil Zaheer.)

On p. 456, the correct answer to Exercise (10.4)(a) is 'Two' and not 'Four', because the case $\sin x = -1$ has to be discarded since $\tan x$ and $\sec x$ are undefined when $\sin x = -1$, i.e., when $x = \frac{3\pi}{2}$. (Pointed out by Kumar Anand.) Also, a slicker solution to (c) is possible from the inequalities $x(x + 1) \geq 0$ and $x^2 + x + 1 \leq 1$, implied, respectively, by the radical sign and the domain of the inverse sine function. Together, they give $x^2 + x = 0$.

On p. 458, in the solution to Exercise (10.24), a purely geometric argument can be given by noting that $\dfrac{1}{a^2} + \dfrac{1}{b^2}$ and $\dfrac{1}{p^2} + \dfrac{1}{q^2}$ both represent the reciprocal of the square of the distance of the origin from the line L, which is independent of coordinates.

On p. 490, a shorter proof of the inequality (8) can be given by writing the L.H.S. as the sum of three terms, viz. as $\cos x + \cos x + \sec^2 x$ and applying the A.M.-G.M. inequality.

*On p. 509, in Exercise (13.19), the condition $-\frac{\pi}{2} \leq x \leq \frac{\pi}{2}$ should be replaced by $-\frac{\pi}{2} < x < \frac{\pi}{2}$. However, then there are no values of λ for which f has a (global) maximum and also a (global) minimum. If the problem is taken to mean a local maximum and a local minimum, then the answer is $\lambda \in (-\frac{3}{2}, 0) \cup (0, \frac{3}{2})$. This is obtained by putting $u = \sin x$, and noting that the derivative of the function $g(u) = u^3 + \lambda u^2$ must have two distinct roots in the interval $(-1, 1)$. (Pointed out by Sameer Kulkarni.)

On p. 546, in the solution to the first problem, implicit differentiation gives $3y^2y' + 6x = 12y'$ (instead of $3y^2y' + 6x = 12$). As a result, the subsequent calculations change too. y' comes out as $\frac{2x}{4-y^2}$. For a vertical tangent, $4 - y^2$ must vanish, giving $y = \pm 2$ and correspondingly, $3x^2 = 12y - y^3 = \pm 16$. As x^2 cannot be negative, the value $y = -2$ has to be discarded. The value $y = 2$ gives $(\pm\frac{4}{\sqrt{3}}, 2)$ as the two points on the curve where the tangent is vertical. (Pointed out by Harshad Sahasrabuddhe.)

On p. 569, in the first problem in Comment No. 15, the given function $f(x)$ is actually differentiable at $x = 1$. The function $(x-1)^2 \sin \frac{1}{(x-1)}$ would be differentiable at $x = 1$ if it is set equal to 0 at $x = 1$. Also $-|x|$ is differentiable at $x = 1$ and has value -1 there. Adding the two gives the differentiability of f at $x = 1$. (Pointed out by Prakash Pethe.)

On p. 591, in lines 10 and 11 and also in the figure replace c by c_1 as the symbol c is already used for something else. Also in line 13 from the bottom, the notation $f^{-1}(y_0-\delta, y_0+\delta)$ indicates the image of the interval $(y_0-\delta, y_0+\delta)$ under the function f^{-1}. Strictly speaking, it should be denoted by $f^{-1}((y_0-\delta, y_0+\delta))$. That is, there should be two pairs of parentheses, one nested in the other, with the inner one to denote an open interval and the outer one to denote the action of the function f^{-1}. But in such situations it is customary to write just one pair of parentheses to do both the jobs.

On p. 597, in the definition of $\phi(x)$ in line 2, remove the expression '$= 0$' appearing at the end.

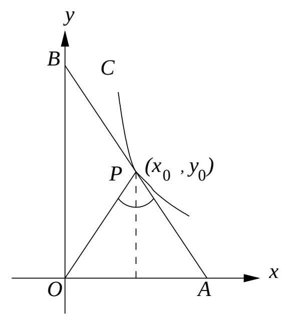
On p. 668, it is mentioned that the integral $\displaystyle\int_0^{\pi/2} \frac{\sin((2m-1)u)}{\sin u}\, du$ can be evaluated using Chebychev polynomials. Actually, an easy evaluation is possible. Call this integral as J_m for $m \geq 1$. Then the integrand of $J_{m+1} - J_m$ can be written as $\displaystyle\frac{2\cos(2mu)\sin u}{\sin u} = 2\cos(2mu)$. But then $J_{m+1} - J_m$ equals $\displaystyle\int_0^{\pi/2} 2\cos 2m\pi\, du = \frac{1}{m}\sin(2mu)\Big|_0^{\pi/2} = 0$. Thus we have shown that $J_{m+1} = J_m$ for all $m \geq 1$. A direct calculation gives $J_1 = \pi/2$. This proves (12) on p. 668 and gives an alternate (and a more direct) solution to the problem.

On p. 711, the denominator of the integrand in the last integral in Line 6 should be $5t^2 + 6t + 5$ instead of $5t^2 + 6t + 1$. This changes the solution considerably because now the denominator no longer factorises as a product of linear polynomials. The correct solution is $y = \dfrac{1}{3}\tan^{-1}\left[\dfrac{4\tan(4x + \tan^{-1}\frac{3}{4}) - 3}{5}\right] - \dfrac{5}{3}x$. (Pointed out by Aveek Sen.)

On p. 713, a simpler derivation of the differential equation (55) and also of its solution can be given as follows. (Contributed by M. R. Railkar.)

Let $P = (x_0, y_0)$ be a point on C. Let the tangent to C at P meet the axes at A and B respectively. Since P is the midpoint of AB, we have $A = (2x_0, 0)$ and $B = (0, 2y_0)$. Hence the slope of AB is $-\frac{y_0}{x_0}$. But as this line touches C at P, its slope also equals the value of $\dfrac{dy}{dx}$ at (x_0, y_0). Hence

$$\left(\frac{dy}{dx}\right)_{x=x_0} = -\frac{y_0}{x_0}$$



(This is also obvious from the diagram if we observe that P being the midpoint of the hypotenuse of a right angled triangle AOB, the triangle OPA is isosceles. So the lines PO and PA are equally inclined to the vertical line at P. Hence their slopes are negatives of each other.)

As P_0 was *any* point on C, we can as well replace x_0 and y_0 by x and y respectively to get

$$\frac{dy}{dx} = -\frac{y}{x}$$

For an alternate solution of this differential equation, simply rewrite it as $xdy + ydx = 0$ and integrate to get $xy = k$, a constant.

The correct spelling of the word 'parallelopiped' used on p. 743 and later is 'parallelepiped'. But now the incorrect spelling is standard. (Pointed out by M. R. Railkar.)

On p. 804, in the answer to the Ruin Problem, in addition to the cases considered, a ruin can occur at the end of the 14-th round also when there is exactly 1 head in the first 10 rounds, exactly one head in the next two rounds and no head in the 13th and the 14th round. The probability of this is $\binom{10}{1}pq^9 \times \binom{2}{1}pq \times q^2 = 20p^2q^{12}$. Hence the answer to the problem is $q^{10}(1+10pq+65p^2q^2)$ which, in the case of a fair coin reduces to $\frac{121}{16,384}$. (Pointed out by Vivek Saxena.)

On p. 807, Exercise 22.6 (b) can be worked out with the given values. But the data is inconsistenct since $P(ABC)$ can never exceed $P(AB)$ as is given.

On p. 820, in line 18, delete the last sentence as there is no Exercise (23.20) in the text.

On p. 902, the answer to Exercise (13.2) is the ratio of the sides of the rectangular part of the window which admits maximum light. The function $f(a)$ given in the solution should be $ac - 2a^2 - \frac{3\pi}{4}a^2$.

On p. 902, the answer to Q. 4(i) is $\frac{3\sqrt{3}}{4}r^2$ and not $\frac{3\sqrt{3}}{8}$ because the area of the triangle PQR is twice that given in the solution.

On p. 903, the correct answer to Exercise (13.9) is (A). As $h(x)$ is decreasing on $[0, \infty)$, we have $h(x) \leq h(0) = 0$ for all $x \in [0, \infty)$. But f and hence h assumes only non-negative values. This forces $h(x) = 0$ for all $x \in [0, \infty)$. (Pointed out by Ankit Thakur.)

On p. 907, the correct answer to Exercise (15.3) is that none of the given statements is true. All that can be concluded from the data is that a and b are of opposite signs as the normal must have positive slope.

On p. 908, the correct answer to Exercise 7(c) is $x + y = 1$. (When $x = 0$, y equals 1. In the equation for y', the expression $\frac{y}{\ln(1+x)}$ ought to be $\frac{y}{(1+x)}$. Putting $x = 0, y = 1$ gives $y' = 1$. Hence the slope of the normal at $(0, 1)$ is -1.

On p. 913, the answer to Exercise 22(a) should be differentiable everywhere, since $f'_-(0)$ and $f'_+(0)$ both equal 1.

On p. 914, in the answer to Exercise (15.25)(b)(ii), the function $f(x)$ does have an inverse on $[1, \infty)$ defined by $f^{-1}(x) = \frac{1}{2}(1 + 4\log_2 x)$. Note however, that the function f is not one-to-one on $I\!R$ since $f(x) = f(1 - x)$ for all $x \in I\!R$. (Pointed out by Manzil Zaheer.)

On p. 917, a purely algebraic solution to Exercise (16.20) can be given by expressing a_1 and a_2 in terms of the roots of $p(x)$, say $r_1, r_2, \ldots, r_n$. The given condition then reduces to $(n-1)\sum\limits_{i=1}^{n} r_i^2 < 2\sum\limits_{i<j} r_i r_j$ and hence to $\sum\limits_{i<j}(r_i - r_j)^2 < 0$ which is a contradiction if all r_i's are real. (Contributed by Vivek Saxena.)

On p. 919, in the answer to Exercise (17.3)(vi), the point C should be $(-1, 2)$ and not $(1, 2)$. Also the correct answer is $\displaystyle\int_{-1}^{2} \sqrt{5 - x^2}dx - 2 - \frac{1}{2}$ which comes out as $\frac{5}{2}(\sin^{-1}(\frac{2}{\sqrt{5}}) + \sin^{-1}(\frac{1}{\sqrt{5}}) + \frac{4}{5}) - \frac{5}{2} = \frac{5\pi}{4} - \frac{1}{2}$. (The area under the arc CB can also be found by adding the area of the sector OBC and that of the triangles OCE and OBD.)

On p. 930, in the solution to Exercise (19.10), it is preferable (and easier) to derive the differential equation in terms of $\frac{dx}{dy}$ since it relates more easily to the slope of the normal (which is simply $-\frac{dx}{dy}$). On squaring the distances, the equation we get is $y^2(\frac{dx}{dy})^2 = 2xy\frac{dx}{dy} + x^2(\frac{dx}{dy})^2$. So, at every point of the curve, one of the two possibilities holds, viz. either (i) $\frac{dx}{dy} = 0$ or (ii) $y^2\frac{dx}{dy} = 2xy + x^2\frac{dx}{dy}$. The second possibility leads to the solution given. But the first possibility also gives a valid solution, viz. the vertical line $x = 1$. The complete solution, therefore, is the union of the circle $x^2 + y^2 = 2x$ and the straight line $x = 1$. If one insists upon a single equation in x and y whose solution set is this union of two curves, it is $(x - 1)(x^2 + y^2 - 2x) = 0$. (Pointed out by Manzil Zaheer. Actually, the reasoning needed here is much more subtle. All we can get immediately from the equation $y^2(\frac{dx}{dy})^2 = 2xy\frac{dx}{dy} + x^2(\frac{dx}{dy})^2$ is that at every point of the curve, *either* (i) *or* (ii) holds. It *does not* follow automatically that either (i) holds throughout for the curve or (ii) does. To conclude this would be as absurd as saying that since every human being is either a man or a woman, therefore, either every human being is a man or else every human being is a woman! To solve either (i) or (ii), we need to know that it not only holds at a point of the curve, but in some neighbourhood of that point. To deduce this from the equation $y^2(\frac{dx}{dy})^2 = 2xy\frac{dx}{dy} + x^2(\frac{dx}{dy})^2$ rigorously requires theoretical calculus of functions of two variables and completeness of the real line. It is well beyond the JEE level.)

On p. 935, in the answer to Exercise 20, only the functions in (A) satisfy the given equations about the composites. So would those in (C), if we repalce $g(x) = \sin\sqrt{x}$ by $g(x) = |\sin\sqrt{x}|$. So, the given composites of f and g do not force (A) to be true. In fact, they do not determine f and g uniquely. So (D) is the only correct statement. (Pointed out by Manzil Zaheer.)

On p. 953, the correct answer to Exercise (23.15) is 'Rupees $-\frac{825}{2401}, \frac{240}{2401}$ and $\frac{585}{2401}$ respectively'. If the game ends on the n-th toss, then A's net gain is $2k$ if $n = 3k+1$, $-k$ if $n = 3k-1$ and $-k$ if $n = 3k$. So, the expected net gain of A equals $\sum_{k=0}^{\infty} 2kq^{3k}p - \sum_{k=1}^{\infty} kq^{3k-2}p - \sum_{k=1}^{\infty} kq^{3k-1}p$ where $p = \frac{2}{5}$ and $q = 1 - p = \frac{3}{5}$ which comes to $-\frac{2q^2+q}{(1+q+q^2)^2}$. Similarly, the expected net gains of B and C come out to be $\frac{q-q^3}{(1+q+q^2)^2}$ and $\frac{2q^2+q^3}{(1+q+q^2)^2}$ respectively.

On p. 958, there is only one solution to the equation. Even though the resulting quadratic has 2 and 5 as two roots, $x = 2$ cannot satisfy the original equation as logarithms of negative numbers are not defined.

A few more corrections are tabulated in the tables below. (A negatively numbered line is to be counted from the bottom.) A reader who notices any other mistake is urged to contact the author immediately, preferably on the e-mail (kdjoshi@math.iitb.ac.in) or on the phone (022) 25767467 (office) or (022) 25768467 (residence) or 9819961036, 9713612285 (mobile). Alternate solutions are also welcome. Those that are particularly elegant or instructive will be displayed on this webpage along with the names of their first contributors (except when they request anonymity).

The second edition of the book has appeared. Errors corrected after it came out are listed in the errata for the second edition. Some of them refer to material which is only in the second edition. The others also apply for the first edition with minor changes of pagination or the line numering.

Page (line)	*For*	*Read*
v(ii) (-7)	genrally	generally
5 (14)	decompositiion	decomposition
11 (-12)	permutaion	permutation
17 (20)	closed parentheses	right parentheses
22 (24)	$\frac{20}{6^n}$	$\frac{20}{2^n}$
26 (-20)	$3^3 > 27$	$3^3 > 24$
36 (16)	two ot	two or
41 (9)	interval $\frac{1}{b}, \frac{1}{a}$	interval $[\frac{1}{b}, \frac{1}{a}]$
61 (-3)	$e^i y = \cos y + i \sin y$	$e^{iy} = \cos y + i \sin y$
65 (1)	$i(x_1y_2 - x_2y_1)$	$i(x_1y_2 + x_2y_1)$
84 (13)	$\mathbf{A}' + \mathbf{B}'$	$\alpha\mathbf{A}' + \beta\mathbf{B}'$
85 (-2)	characterisitc	characteristic
86 (heading)	Theoty	Theory
86 (8)	$x + 3 = 7$	$x + 4 = 7$
90 (-14)	worry	to worry
91 (Equation (11))	$\sum_{i=1}^{n}$	$\sum_{i=1}^{n} \alpha_i$
95 (7)	Exercise (7.5)	Exercise (7.4)
120 (12)	$16a^2e$	$16a^3e$
121 (13)	$ax^2 + bx + c$	$ax^2 + bx + c = 0$
129 (-15)	$(11 - k)$	$(13 - k)$
138 (8)	2^j	p^j
150 (-11)	$-3 \times 1092 - 17 \times 195$	$-3 \times 1092 + 17 \times 195$
153 (19)	$0, 1, 2, \ldots, 40$	$0, 1, 2, \ldots, 39$
153 (20)	$x = 41$	$x = 40$
187 (11)	0 to n	0 to $n - 1$
193 (-16)	$x > c$	$x > -c$
198 (-14)	at least	at most
212 (-5, -4)	$y + 2z + w$	$7y + 2z + w$
228 (9, 10)	$= \frac{1}{2}($	$= ($
233 (-9)	an $n \to \infty$	as $n \to \infty$
246 (-15)	(26)	(21)
251 (9)	$-2 \cot \alpha$	$-2 \cot 2\alpha$
263 (11, 13)	$\frac{(m^2 - 1)(b - c)}{2}$	$\frac{(m^2 - 1)(b - c)}{2m}$
263 (-9)	$(1 - m^2)(b - c)$	$(1 - m^2)(b^2 - c^2)$
284 (15)	$e^{-i\pi/4}$	$\frac{1}{r}e^{-i\pi/4}$
292 (2)	$\frac{1}{2}(x - 1)^2$	$\frac{1}{4}(x - 1)^2$
293 (22)	$(\frac{2}{5}, \frac{1}{5})$	$(\frac{2}{5}, -\frac{1}{5})$
293 (22)	$(-\frac{2}{5}, -\frac{1}{5})$	$(-\frac{2}{5}, \frac{1}{5})$
298 (7)	determinant	determinant by 2

Continued ...

Page (line)	*For*	*Read*
311 (-1)	$E_1 + \lambda_2$	$E_1 + \lambda E_2$
315 (-19)	$(2p + 5q + 6)$	$(4p + 5q + 6)$
319 (21)	$= 1$	$= 0$
331 (heading)	Triconometry	Trigonometry
340 (5)	compodendo	componendo
349 (5)	$f(3 + \delta) > 0$	$f(3 + \delta) < 0$
349 (5)	$f(4) < 0$	$f(4) > 0$
370 (11)	the Main Problem	this problem
379 (-10)	isoceles	isosceles
411 (-6)	5^{10}	10^5
412 (2)	$(m-1)!\binom{m}{n}$	$(m-1)!\binom{m}{n}n!$
412 (-12)	Exercise (1.26)	Exercise (1.27)
414 (-4)	$a = 7, b = 6$	$a = 5, b = 8$
419 (6)	$x = -\frac{5}{36}, y = -\frac{1}{9}$	$x = -\frac{1}{4}, y = -\frac{1}{4}$
419 (7)	$x + y = -\frac{1}{4}$	$x + y = -\frac{1}{2}$
419 (8)	$\frac{x}{y} = \frac{5}{4}$	$\frac{x}{y} = 1$
419 (12)	$\alpha(\alpha + \beta)$	$\alpha^2\beta$
419 (12)	$\beta(\alpha + \beta)$	$\alpha\beta^2$
420 (-12)	$a_1b_2 - a_2b - 1$	$a_1b_2 - a_2b_1$
421 (-16)	$\lambda_1, \lambda_2, \lambda_3$	$\lambda_1, \lambda_3, \lambda_4$
421 (-4)	$x_1, x - 2$	x_1, x_2
422 (-12)	$2Bm + c$	$2Bm + C$
422 (-5)	powers of 1	powers of 10
426 (-11)	$\sqrt{u + v + 2\sqrt{uv}}$	$\sqrt{u + v - 2\sqrt{uv}}$
430 (-15)	$= (\frac{1+i\sqrt{3}}{2})^{6m}$	$= (\frac{1-i\sqrt{3}}{2})^{6m}$
445 (-16)	A and B	z_1 and z_2
449 (2,3)	or even to .... etc.	separately
450 (6)	$x^2 + xy - 2y^2 = 4$	$16x^2 + 10xy + y^2 = 2$
450 (21)	$\frac{31}{16}$	$\frac{31}{4}$
451 (4)	$y^2 - 6y + 10x + 5$	$y^2 - 6y - 10x + 14$
451 (4)	$(h-2)^2 + (y-2)^2$	$(h-3)^2 + (k-3)^2$
451 (17)	$4x^2 + y^2 = 4x^2y^2$	$4x^2 + 25y^2 = 4x^2y^2$
451 (22)	$x - y + 5 = 0$	$x - 3y + 5 = 0$
451 (-7)	$\sqrt{2}$ (four occurrences)	1 (all occurrences)
453 (3)	$y = -\frac{\sqrt{3}}{2}x$	$y = -\sqrt{3}\,x$
456 (8)	$[0, \frac{\pi}{3}] \cup [\frac{5\pi}{6}, \pi] \cup \{1\}$	$[0, \frac{\pi}{6}] \cup [\frac{5\pi}{6}, \pi] \cup \{\frac{\pi}{2}\}$
456 (13)	$\sin p \leq 0$	$\sin p \geq 0$
456 (-7)	. hence	. Hence
456 (8)	$[0, \frac{\pi}{3}] \cup [\frac{5\pi}{6}, \pi] \cup \{1\}$	$[0, \frac{\pi}{6}] \cup [\frac{5\pi}{6}, \pi] \cup \{\frac{\pi}{2}\}$
456 (13)	$\sin p \leq 0$	$\sin p \geq 0$
456 (-7)	. hence	. Hence

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Page (line)	*For*	*Read*
457 (-18)	$2\sqrt{2}-4)$	$(2\sqrt{2}-4)$
457 (-16)	eqatuing	equating
470 (-11)	constannt	constant
479 (22)	2π	π
481 (footnote)	polularly	popularly
490 (-10)	$g(x)=2x$	$g(x)=3x$
495 (7, 14)	minimise	maximise
495 (-3)	$\frac{\pi}{3}$ and $\frac{5\pi}{3}$	$\frac{\pi}{6}$ and $\frac{5\pi}{6}$
496 (20)	$\dfrac{4}{a^2-4}$	$\dfrac{8}{a^2-4}$
501 (5)	onjective	objective
502 (3,5,10)	$\frac{2\sqrt{2}}{3}$	$\frac{2\sqrt{2}}{\sqrt{3}}$
504 (13)	$x-1$	x_1
517 (10, 11)	π	$\pi/2$
517 (13)	$\tan\dfrac{\pi}{3}$	$3\tan\dfrac{\pi}{3}$
521 (14)	exmination	examination
522 (-14)	$(s-a)(s-b)$	$(s-b)(s-c)$
526 (8)	genrally	generally
548 (9)	$\sin(x^2+1)\times 2x$	$\sin((x^2+1)^2)\times 2x$
548 (9)	$2x\sin(x^2+1)$	$2x\sin(x^4+2x^2+1)$
550 (-3)	from the right	from the left
550 (-3)	from the left	from the right
561 (8)	So,	So, in this deleted δ - neighbourhood
561 (11)	$\lvert 1-L\rvert+\lvert -1-L\rvert=1+1$	$\lvert 1-L\rvert+\lvert -1-L\rvert<1+1$
568 (1)	$y=\frac{1}{y}$	$y=\frac{1}{x}$
576 (10)	$e^x\cos x$	$e^{2x}\cos x$
579 (-15, -9)	Comment No. 21	Comment No. 19
585 (18)	and (2) will	and (4) will
586 (-19)	$f(a)\le f(b)$	$f(a)\le m\le f(b)$
589 (-16)	$f(x)=\sin x$	$f(x)=\cos x$
589 (-16)	$[0,\pi]$	$[0,3\pi]$
591 (9)	$f(x_1)$ and $f(x_3)$	$f(x_1)$ and $f(x_2)$
591 (24)	Applying the MVT	Applying the IVP
596 (21)	$r-1$ (second occurrence)	$r-2$
610 (14)	ia	is
616 (18)	Comment No. 8	Comment No. 9
622 (9)	$2\pi r.$	$2\pi r).$
622 (-1)	$\dfrac{x}{2}$	$\dfrac{x}{2}\sqrt{r^2-x^2}$
628 (-18)	$2+x^2$	$2+x$
635 (-17)	$-\frac{1}{a}\sin(ax+b)$	$-\frac{1}{a}\cos(ax+b)$
636 (-11)	$\dfrac{B_kx+C_k}{(x+b_r)^2+c_r^2}$	$\dfrac{B_rx+C_r}{(x+b_r)^2+c_r^2}$

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Page (line)	*For*	*Read*
640 (-14)	$\frac{1}{4}\sin(2u)$	$\frac{r^2}{4}\sin(2u)$
640 (-13)	$2r^2x\sqrt{r^2-x^2}$	$\dfrac{2x\sqrt{r^2-x^2}}{r^2}$
642 (-1)	D_r	D_m
647 (-7)	$\displaystyle\int$	$\dfrac{1}{m}\displaystyle\int$
648 (11)	$\displaystyle\int F'(x)g(x)dx$	$\displaystyle\int F'(x)G(x)dx$
651 (7)	functionon	function
651 (7)	of $f(x)$	of x
655 (15)	$\dfrac{1}{n}\displaystyle\sum_{r=1}^{n}\sin(\dfrac{\pi r}{n})$	$\displaystyle\lim_{n\to\infty}\dfrac{1}{n}\sum_{r=1}^{n}\sin(\dfrac{\pi r}{n})$
655 (16)	$\dfrac{1}{n}\ln\dfrac{(2n)!}{n^n n!}$	$\displaystyle\lim_{n\to\infty}\dfrac{1}{n}\ln\dfrac{(2n)!}{n^n n!}$
657 (1)	maximum	minimum
657 (-15)	separately	separately)
657 (-11)	variable t)	variable t.
668 (1)	(12)	(10)
681 (-2)	$\tan^{-1}1-\tan^{-1}(-1)=\pi$	$\tan^{-1}1-\tan^{-1}(-1)=\frac{\pi}{2}$
681 (-2)	$I=\frac{\pi^2}{2}$	$I=\frac{\pi^2}{4}$
681 (-1)	$2\pi^2$	π^2
683 (10)	$\int_0^{\pi/2}\sin 2x\cos x\ dx$	$\int_0^{\pi/2}f(\sin 2x)\cos x\ dx$
685 (16)	$[x]^2$	$[x^2]$
687 (-1)	$\displaystyle\int_{\pi/2}^{\pi/2}$	$\displaystyle\int_{-\pi/2}^{\pi/2}$
688 (-10)	$\int f(\sin x)\ dx$	$\int\limits_0^{\pi} f(\sin x)\ dx$
698 (5)	deacy	decay
700 (13)	arbitray	arbitrary
701 (2)	natrure	nature
704 (-9)	$2x^2+2y^2$	x^2+y^2
704 (-8)	$2x^2+2y^2$	x^2+y^2
706 (-5)	function of of	function of
712 (-7)	vx	$v\cot x$
726 (20)	$(a+b-1)f(1)=-5$	$(a+b)f(1)=-4$
726 (21)	$a+b\neq 1$	$a+b\neq 0$
736 (10)	oppositie	opposite
759 (-4)	$(\mathbf{a},\mathbf{b},\mathbf{c})$ and $(\mathbf{a},\mathbf{b},\mathbf{c})$	$(\mathbf{b},\mathbf{c},\mathbf{a})$ and $(\mathbf{c},\mathbf{a},\mathbf{b})$
759 (-4)	system $(\mathbf{a},\mathbf{b},\mathbf{c})$	system $(\mathbf{a},\mathbf{c},\mathbf{b})$
787 (8)	Chapter 3	Chapter 5
788 (-18)	determied	determined
792 (-14)	$\frac{1310}{10000}$	$\frac{1390}{10000}$
792 (-13)	13.10%	13.90%

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Page (line)	*For*	*Read*
793 (13)	C(Exactly	P(Exactly
793 (13)	one of A and A	one of C and A
793 (19)	$P(CA' \cup P(C'A)$	$P(CA' \cup C'A)$
795 (5)	evey	every
804 (-3)	$x^2 - (1-p)x + p(1-p)$	$x^2 - (1-p)x - p(1-p)$
814 (-13)	$f(T) = p$	$f(H) = p$
852 (4)	ncessarily	necessarily
853(20)	serous	serious
874 (-20)	Main problem	Main Problem
897 (3)	$x - \frac{x^2}{2} + \frac{x^4}{4}$	$x - \frac{x^2}{2} + \frac{x^3}{4}$
903 (1)	$\frac{a^2-b^2}{a}$	$\frac{(a+b)^2}{a}$
903 (20)	$b < -2$	$-2 < b < -1$
903 (20)	$b > 1$	$b \geq 1$
903 (-13)	**12.** (C).	**12.** (D).
907 (10)	$\frac{(4x_0+1)^3}{16x_0^4}$	$\frac{(4x_0^2+1)^3}{16x_0^4}$
907 (10)	$64x_0^3(4x_0^2+1)^2$	$64x_0^3(4x_0^2+1)^3$
907 (-23)	$x_2 = 2x_1$	$x_2 = -2x_1$
907 (-22)	$x_3 = 2x_2, x_4 = 2x_3$	$x_3 = -2x_2, x_4 = -2x_3$
907 (-21)	ration	ratio
907 (-20)	4	16
909 (7)	$\frac{32}{\pi^2+16}$	$-\frac{8}{\ln 2} + \frac{32}{\pi^2+16}$
909 (7)	$1 + 2\tan^{-1} x$	$(\frac{\ln \sin x}{\ln \cos x})^2 + 2\tan^{-1} x$
911 (1)	$\frac{2}{\sqrt{3}}$	$\frac{2}{3\sqrt{3}}$
911 (19)	$-1 \leq < 0$	$-1 \leq x < 0$
911 (19)	limit is -1	limit is 1
911 (20)	(i) 5.	(i) 1.
911 (20)	$f(x) = 2$	$f(x) = \sin x$
911 (20)	$g(f(x)) = 5$	$g(f(x)) = \sin^2 x + 1$
912 (8)	if $0 \leq x$ (at end)	if $x \geq 1$
912 (19)	$7 - (342.99)^3$	$7 - (342.99)^{1/3}$
912 (-6)	of g	of f
912 (-5)	$(f+g) - g$	$(f+g) - f$
912 (-5)	of f	of g
913 (1)	(b) 0.	(b) $\frac{3}{2}$.
913 (2)	$e^x \cos x$	$e^{2x} \cos x$
913 (6)	$g(x) \equiv x$	$g(x) \equiv x - 4$
913 (7)	all $x > 16$	all $x \geq 4$
913 (19)	at 1 and 2	at 0 and 1
913 (-3)	$[-2a, \frac{a}{3}]$	$[-2/a, \frac{a}{3}]$
913 (-2)	$e^{ax}(2a + x)$	$ae^{ax}(ax + 2)$

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Page (line)	*For*	*Read*
915 (1)	$f(x)-f(x-\frac{1}{2})$	$f(x-\frac{1}{2})-f(x)$
917 (4)	$A=n(n-1)\ldots 2=\frac{n!}{2}$	$A=n(n-1)\ldots 3=\frac{n!}{2}$
920 (7)	(x) $\frac{1}{3}$	(x) $\frac{10}{3}$
920 (-9)	$\frac{e^2+1}{4e}$	$\frac{e^2-5}{4e}$
922 (-7)	$\sum_{r=1}^{100}$	$\sum_{r=1}^{10000}$
923 (-14)	at 5	at 3
923 (-8)	$\cos x\int_0^x \sin u\, du$	$\cos x\int_0^x f(u)\sin u\, du$
923 (-2)	$2x_0\sin(x_0^2)$	$\frac{1}{x_0^2}\sin(x_0^2)$
924 (-11)	$-\frac{1}{4}x^2$	$\frac{1}{4}x^2$
928 (-2)	$\int\limits_0^1 \frac{x^n}{1+x^2}dx \le \int\limits_0^1 x^n dx = \frac{1}{n+1}$	$\int\limits_0^1 \frac{2x^{n+1}}{(1+x^2)^2}dx \le \int_0^1 2x^{n+1}dx = \frac{2}{n+2}$
930 (4)	$4m$	$-4m$
930 (8)	$\sqrt{1-xy}$	$2\sqrt{1-xy}$
934 (-12)	and $f(T)=0$	and $g(T)=0$
935 (-5)	$f''(x)-f(x)$	$f''(x)=-f(x)$
935 (-5)	$g''(x)-g(x)$	$g''(x)=-g(x)$
942 (11)	$\cos^{-1}\frac{5}{6}$	60°
944 (-11)	$(0,\mathbf{j})(0,\mathbf{k})$	$(0,\mathbf{j})(0,\mathbf{i})$
947 (12)	$(\frac{2}{3})^7$	$(\frac{3}{5})^7$
948 (15)	toatal	total
955 (-15)	$(1-\lambda)+z_1+\lambda z_2$	$(1-\lambda)z_1+\lambda z_2$
957 (-13)	1.	2.
957 (-13)	$m=-1$	$m=-1,-2$
958 (12)	$-\pi$	π
965 (-13)	evey	every